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OBSERVATIONS
ON THE
LINEN MANUFACTURE,
PARTICULARLY
BLEACHING.

Pointing out the Source of the Damage LINENS ſuſtain
in that Proceſs, including Strictures on

An ACT of PARLIAMENT,

MADE LAST SESSION,

Prohibiting the Admixture of LIME with POTASH,
and Experimentally ſhewing it to be founded in Error.

TO WHICH ARE ADDED,

Some new Remarks on AGRICULTURAL KNOWLEDGE,

AND A FEW ON

MINERAL WATERS.

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By MICHAEL DEASE, M. D.

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MDCCLXXXIII.

BRITISH MUSEUM

TO HIS
EXCELLENCY
George Nugent Grenville,
Earl Temple,

LORD LIEUTENANT GENERAL, AND GENERAL
GOVERNOR OF
IRELAND.

MY LORD,

IT is not the circumſtance of your elevated birth, neither is it that of the ſplendour and dignity of your high appointment, induces me to addreſs you; ſuch diſtinctions ſometimes depend more upon accident, than on real merit, and of conſequence may indiſcriminately become the contingent portion of the good man or the bad; but experience has already evinced, and the moſt valid facts announce, that your Excellency has the beſt founded claim to a brave and generous nation's love and eſteem, by the exertion of every virtue can actuate a noble mind. Yours, my Lord, have been called into action by objects worthy of them---the eſtabliſhment of a kingdom's rights on a ſolid baſis, the encouragement of her trade, and the direction of her councils. The grand object of *unequivocal ſecurity in commercial and civil liberty*, I ſee on the eve of completion, under your Excellency's auſpicious government. The glorious event will hand your name to future times with conſpicuous honour, and render it particularly dear to Iriſhmen; for what actions is human nature capable of, more godlike, than ſuch as conduce to the happineſs of millions? The conſideration of the decided part you have taken in whatever relates to the advantage of this nation, from the happy period of your arrival among us, flattered the ambition I conceived, of dedicating to your Excellency theſe Obſervations, as they allude to a preſumed error in the late Linen Act. Should your Excellency approve of the liberty I have taken, and receive it as an humble mark of my reſpect, it will confer the greateſt honour on

Your EXCELLENCY'S

Moſt humble

Obedient Servant,

MICHAEL DEASE.

Feb. 23, 1783,

PREFACE.

IN giving the following ſheets to the Publick, I have entirely ſwerved from my firſt intention: my original deſign was, to publiſh a medical work, which being the reſult of much obſervation during twelve years extenſive practice, I flattered myſelf might be of ſome utility.

I was led to preface my deſigned treatiſe by an introductory diſcourſe on the advancement of ſcience, but more particularly of chymiſtry within this ſhort period, in which having occaſionally adduced the late linen act, as an example of error, ariſing from a defect of ſcientifick information on the ſubject; upon a reviſion of my introductory matter, this article ſtruck me more forcibly, and ſeemed magnified in its importance; the more I turned my attention to this point, the more it appeared to me to merit particular diſcuſſion, and minute inveſtigation: it alſo occurred to me, that to incorporate it with a medical work, might appear an impropriety in the publick eye, and be looked on as heterogeneous matter; although convinced theſe ſubjects are not ſo disjunct in their nature, as they may ſeem at firſt view, as all the thoughts I have offered either on the linen manufacture, or agriculture, come directly within the verge of chymiſtry, which is one of the pillars of phyſick, I felt notwithſtanding, with its full force, the eligibility of ſeparating them from the latter; for which reaſon, I poſtponed my medical work, in order at preſent to ſubmit my ideas on the matters the title of this eſſay expreſſes, to the candour of publick deciſion.

Defects in arrangement of materials, or elegance of ſtyle, will I flatter myſelf be overlooked, ſhould the information conveyed, be deemed of any conſequence in reſpect of the important objects it relates to. I have divided the work into three ſections, the firſt is on the linen manufacture, the ſecond on agriculture, the third contains a view of the beneficial influence of literary ſocieties on the progreſs of the arts and ſciences, and alſo an extract of ſome of their prize queſtions, with a few obſervations on mineral waters.

The freedom of my animadverſions on the want of literary inſtitutions, and on the low ebb of ſcience in this kingdom, aroſe from the pureſt motive and beſt intention; the ſame friendly one, that directs the ſurgeon's hand to the uſe of the probe or cauſtick. As the glorious revolution from bondage to liberty, from annihilated commerce to free trade, have happily taken place; it is to be ſuppoſed and devoutly to be wiſhed for, by every true friend to this country, that the arts and ſciences will emerge from their preſent ſtate of neglect by having a due degree of attention paid to their cultivation, by which, joined to a ſteady perſeverance in induſtry, and ſpirited exertions in commerce, the honour of the nation will ſhine with dignified luſtre, and her improvement advance with quick and ſure ſteps.

OBSER-

OBSERVATIONS
ON THE
LINEN MANUFACTURE.

SECTION I.

IN proportion to the elaborate inveſtigations of modern philoſophers, the arts and ſciences are daily making a progreſſive improvement. But none have, at leaſt, in point of theory, advanced with more accelerated ſteps than the *chymical art*. It has indeed arrived to a ſtate of perfection unknown to former times, and probably, will to a far greater than it has yet attained. To this, nothing has more contributed, than the cultivation of experimental phyſicks, by which it has ſpread its light around with wide diffuſion, diſpelling the illuſions of bewildered genius, and the miſconceptions of ignorance. By purſuing nature into her moſt hidden receſſes, the mantle of myſtery has been removed from ſubjects, which have been hitherto deemed inſcrutable ; as theſe cannot be ſuppoſed to be generally known, except to profeſſional men, I ſhall ſlightly glance on the moſt ſtriking.

To the indefatigable reſearches of the illuſtrious Prieſtley, we are indebted for the moſt aſtoniſhing diſcoveries. Impelled by a laudable emulation, and animated with a thirſt of knowledge, in no way abated by the painful efforts conſequent to ſuch an undertaking, he has, with unremitted aſſiduity, proſecuted his enquiries on aerial fluids ; and, ſurmounting the innumerable difficulties, which lay ſcattered in his way, by his ſucceſsful efforts, has brought this branch to a degree of perfection, that, although there is ſufficient room left in ſo vaſt a field for future adventurers, muſt appear ſurpriſing to men of ſcience. He has ſtubbed the thorns, and made the way ſmooth for his followers. Many celebrated chymiſts are ſtill purſuing the ſame track, labouring in the mine he has principally opened. For, although ſo far back as Van Helmont the matter has been broached ; and that Hales and Boyle * have gone before him, in analyzing bodies to their elementary

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* Doctor Prieſtley had, no doubt, the advantage alſo of knowing from the ingenious Doctor Black, Profeſſor of Chemiſtry, at Edinburgh, that fixed air could, in great abundance, be procured from chalk, by means of diluted ſpirit of vitriol ; and, from Mr. Cavendiſh, that it could in a large quantity be abſorbed by water.

parts; yet they have fallen ſhort of his extenſive views, and perſpicuous ideas on the ſame ſubject. Theſe chymiſts, not diſtinguiſhing the aerial fluids, to which we now apply the terms of mephytick, or fixed air, inflammable air, or phlogiſton, nitrous air, &c. to be elaſtick diaphanous fluids ſui generis, have confounded them with the atmoſpherick air, attributing the apparent difference to adventitious admixture: but, they are now univerſally acknowledged to conſtitute a particular claſs of fluids, brought to light by the induſtry of modern experimentaliſts, led on by a Prieſtley, who, in the philoſophick world, having explored new regions, may be deemed another Columbus.

To what important purpoſes theſe inventions may be converted, is impoſſible, as yet, not only to aſcertain, but even to form probable conjectures. To the ſcience of healing they promiſe to be of ſingular utility. It has already experienced advantage, as, in ſome inſtances, the practitioner is by them ſupplied with new aſſiſtance in ſubduing diſeaſe.

Our countryman, Macbride, an honour to his nation, has firſt ſucceſsfully applied the antiſeptick virtues of fixed air; and ſince, various are the efforts made by practitioners, in all parts, to apply more extenſively theſe reſources: fixed air has been inhaled in vapour, given in clyſter, and by impregnating water with it, in imitation of the Seltzer and Pyrmont, it can, with advantage, be taken into the ſtomach. Theſe acidulous waters can now be contrived with greater facility, than before we had ſo clear a knowledge of the nature of fixed air.

I am ſenſible moſt phyſicians would prefer the natural to the artificial ſpa. They may ſay the mineral particles, as thoſe generally contain ſome, are in a finer ſtate of diviſion; and, in this reſpect, that the operation of nature is above imitation; that ſhe acts beyond the reach of human power, in ſome inſtances, I will readily allow: in other matters, we not only eaſily overtake, but control and rectify her. And, if it be well conſidered, when theſe waters are prepared by art, they can be better adapted to each caſe, by varying the ſtrength and principles at pleaſure, there might appear to practitioners ſufficient reaſon for altering their ſentiments relative to this point. What makes me dwell on this article, is, the little regard paid by the faculty to an object, I imagine merits their notice; as by their encouragement, theſe factitious ſpas might be had cheap, and liberally diſtributed in hoſpitals among the poor.

By the diſcovery of nitrous air, in which Dr. Prieſtley has no competitor, we have got a new, and ſurer teſt, for trying the purity of common air.* But modern improvements are not limited to diſcoveries of, and experiments on theſe elaſtic fluids. From the purſuit of electrical enquiries, what eſſential advantages have been reaped? The electrician may amuſe himſelf by drawing the lightning from the thunder-cloud, or ſtriking animals dead by his well-conſtructed batteries. Such experiments pleaſe and aſtoniſh. But, averting, by proper conductors, the lightning's ſtroke from our ſhips, and publick buildings, is an invention of the utmoſt importance. The uſe of the electrical aura, in curing diſeaſes, is not ſufficiently eſtabliſhed by facts to inſiſt on, but affords a comfortable proſpect. I have made many trials of its effects in this point of view, but reſerve my ideas on that head to another opportunity.

I did not as yet mention the invaluable practice of inoculation, by which ſo many lives are yearly ſaved to the community. It is to be hoped the prejudices, which ſtill unhappily prevail againſt it, will every day decreaſe, until at length, by being totally diſſipated, and by its univerſal uſe, that formidable diſeaſe may put on a milder aſpect, and be paſſed through with little or no hazard. Then the poiſon may be ſaid to be extracted from under the ſerpent's tooth, and its bite loſe the venom. Her Imperial Majeſty of Ruſſia has encouraged the practice through her wide dominions, not by precept only, but, by getting herſelf inoculated, has glorioully ſet the example to her ſubjects.

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* The method being eaſy, I put to this trial air taken from different quarters of Dublin and its environs, to find their reſpective degrees of purity, and of conſequence general ſalubrity. The reſult I forbear giving, as it would require repeated experiments, in clear ſerene weather, to come to ſome certainty on this point. To procure the air from different parts, in order to experiment upon, it is only neceſſary to bring a bottle, filled with water, to the place on the air of which you intended to make the experiment, and pour the water out in that place, then cork and ſeal it: by filling the bottle with water, you drive out all the air it contained; by emptying it, it will receive the air of the place it is emptied in, then by corking and ſealing you hinder any other to mix with it. By this means you might bring American air to Dublin.

Harriſon's time-keeper, by which the longitude is found at ſea, with an exactitude hitherto unknown, is a diſcovery of theſe days; and for which he has been nobly rewarded by the Britiſh Parliament; but as it does not touch upon *medicine*, the profeſſion I have neareſt at heart, I ſhall not dwell on it.

Edinburgh, in theſe days, proves to be a fruitful ſource of medical inſtruction. Monro, Cullen, Duncan, &c. names great in phyſick, have eſſentially contributed to eſtabliſh its fame in this line, and have thrown new light on many ſubjects; to which the various eſſays, commentaries, &c. carried on in that ſeminary of phyſick, have alſo materially conduced, by giving a conciſe view of the efforts daily made towards its advancement through every part of Europe.

But, at a time when ſurrounding nations are emulous to excel in theſe ſublime purſuits, which ſo much dignify our ſpecies, and that they have inſtituted learned ſocieties for their promotion, it muſt be an unpleaſing reflection to every Iriſhman, a true lover of his country, that Dublin, the third city in Europe in greatneſs, ſhould be the laſt in this noble ſtrife. Even in Ruſſia, ſo lately emerged from a ſtate of barbariſm, the cultivation of ſcientifick knowledge is liberally encouraged. In Sweden, men of abilities meet the moſt ample patronage. Linneus, who has ſurpaſſed, in his line, all who preceded him, whoſe talents have enabled him to new-model and reform, the whole ſcience of natural hiſtory, has received marks of diſtinction from his ſovereign, and has had a due regard ſet upon his merit by his fellow citizens.

Wherever proper incitements are held out, genius will ſpring up. Men actuated by the love of fame, or riches, are ſtartled at no difficulties, nor ſhrink from the moſt arduous undertakings, but, with unrelaxed efforts, purſue honour and fortune through the moſt winding and difficult paths. In the hiſtory of every country, we find a full confirmation of the truth of this aſſertion; and we always ſee ſcience flouriſh, under the foſtering hand of power; but, unprotected, pine, and droop her head. From this cauſe, the Turkiſh empire at this day remains involved in the thickeſt cloud of ignorance. The muſes, baniſhed from their ſeat in Greece, ſo famous in antiquity for every ſpecies of literature, have fled to this part of the world, where they met various degrees of encouragement among the nations: But in Ireland, much to its diſhonour, the leaſt cordial reception. The Dublin Society and Linen Board are the only inſtitutions in this nation for exciting any kind of induſtry, or talent; and, no doubt, the objects of their attention, agriculture, mechanicks, and the Linen manufacture are highly important, and eſſentially conducive to the good of the ſtate. But, I would humbly ſuggeſt, that to attain the laudable ends of theſe ſocieties, they not only confine their ſchemes within too circumſcribed limits, but ſtop ſhort, where they ſhould with greater propriety begin. For, if chymiſtry, and experimental philoſophy, be the parents, and nurſe, of every other art and ſcience, from that of agriculture to the moſt mechanick, the cultivation of the former muſt be the ſhorteſt, and ſureſt road to future improvements and diſcoveries. That they are the fruitful ſource, from which the others derive their origin, is too evident to men of informed minds to bear any diſpute, or ſtand in need of farther proof. Hydroſtaticks, the laws of motion, the nature of the elements, opticks,

&c. apply ſo nearly to the inferior crafts, that they touch at every point. Therefore, to be an improver, or diſcoverer, it can not be denied, that a maſterly diſcernment, and ſcientifick knowledge, are eſſentially requiſite; otherwiſe the ſuperſtructure is without foundation, or reſts upon ſand. It muſt be allowed, that, by the blind experience of revolving ages, ſome things uſeful may be fortutiouſly ſtumbled upon, and ſlowly creep to greater degrees of perfection: But, it will be as eaſily admitted, that, by experience alone, we can not be ſo advantageouſly conducted in our reſearches, or make, with equal celerity, any progreſs in them, as when enlightened by ſcience, and a clear knowledge of the connection between cauſes and effects, we can deduce true concluſions from firſt principles.

The Venetian ſenate, impreſſed with a juſt ſenſe of the ſuperior advantage of an Academy of Sciences, have lately founded one at Padua, in favour of which they have ſuppreſſed two others, one for the Belles Lettres, another, of more recent date, for the encouragement of agriculture.

What I have ſaid of experimental philoſophy, with regard to the ſubordinate arts, is not leſs applicable to chemiſtry: From it's definition, the extenſive influence, and great latitude, it has in theſe matters, are ſelf evident. Macquer defines chemiſtry: The

ſcience, whoſe object is to know the nature and properties of all bodies, by analizing and compounding. He juſtly remarks, it is only to modern chemiſtry this definition is appoſite: The ſole object of the antient, being confined to the purſuit of the philoſopher's ſtone, was but a monſtrous unintelligible jargon, a confuſed heap of occult proceſſes, without meaning or connection. He adds: "L'ancienne et moderne n'ont rien en com-
" mun que le nom; et cette ſeule conformite
" eſt encore un mal pour elle; par la raiſon
" que ç'en eſt un pour une fille pleine d'eſ-
" prit, et de raiſon, mais fort peu connüe,
" de porter le nom d'une mere, fameuſe par
" ſes inepties et extravagances." The antient and modern chymiſtry happily have nothing in common but the name, and even that ſame conformity, is a diſadvantage to the modern, for the reaſon it would be one, for a young woman, full of wit and ſolid ſenſe, but little known in the world, to bear the name of a mother infamous by her folly and extravagance.—But the preſent chemiſtry is built on a clear and ſolid baſis, experiments, aided and elucidated by philoſophick reaſoning. And though, in ſome inſtances, theory may be dubious, or defective; yet, on the whole, it is ſatisfactory to account, in a probable manner, for appearances: It enlarges the enquirer's views to diſtant proſpects, and engages him in purſuits after farther perfection. To expect improvement from experience alone, is like a mariner, who

who ſhould put to ſea without chart, or compaſs. It is poſſible he might make a ſucceſsful voyage; but the probability would lie on the oppoſite ſide, that he ſhould get among ſhoals, or be daſhed againſt the rocks.

I will be bold to adduce an example, where, I humbly apprehend, our legiſlature have been led into error, the very laſt ſeſſion, by not previouſly referring the queſtion to the deciſion of men ſufficiently verſed in chymical knowledge. My apprehenſion alludes to a law enacted, prohibiting the admixture of lime with any lees, or pot-aſh, uſed for bleaching linen. Now there is nothing more certain, than that the ſtrongeſt quick lime, mixed with the common pot-aſh, or any mild alkali, becomes as innocent, and as inert, as powdered chalk; which no perſon will believe could, by its cauſticity, be injurious to linen.

To make the matter better underſtood, I ſhall ſay a few words, in order to give readers, not converſant on the ſubject, ſome idea of the nature of elective attractions, and the doctrine of cauſticity. And, as I think cauſticity better explained according to Macquer's, on the principle of univerſal gravitation, than by Beaumes's inflammable matter, I ſhall adopt the former ſyſtem; although, in my idea, the blending of both would make the more complete.

That both a particular, and general law of attraction, ſubſiſt through nature, is an undoubted fact, whatever may be the cauſe. Philoſophy, without puzzling the caſe more, can only ſay, it is a primary law, impreſſed upon matter by the creator's will : An inherent quality, that eludes the keeneſt reſearch, to which we muſt recur, as a firſt cauſe, in expounding the phenomena of the material world. But, it muſt be particularly remarked, as the art of chemiſtry chiefly depends on it, that there does not exiſt an equal power of attraction between the various ſpecies of matter. On the contrary, every ſpecies has a particular determination to unite with one kind of ſubſtance, in preference to another : And, this predilection in particles of different bodies to unite with each other, and form compounds, conſtitutes the doctrine of elective attractions. A few examples is the readieſt method to make the ſubject intelligible.

EXAMPLE I.

Take a ſhilling, or ſmall piece of ſilver ; pour on it ſome aqua fortis. The aqua fortis, and ſilver, having a mutual tendency to unite to each other, the ſilver is gradually diſſolved. But, to be convinced that the aqua fortis has a greater affinity to other ſubſtances, than to the ſilver ; immerſe a bit of copper in this ſolution, you will then ſee the aqua fortis immediately quit the ſilver it held diſſolved, to ſeize the copper : for, according as the copper diſſolves, the ſilver falls to the bottom *. If you now immerſe a bit of iron in the cupreous ſolution, the aqua fortis, having a ſtronger degree of affinity to the iron, than to any of the former metals, immediately quits the copper, to combine with the iron ; by which the copper, in it's turn, is precipitated to the bottom. If to the iron ſolution you add ſome alkaline ſalt, the iron will be immediately precipitated. You may go on in this manner, diſſolving, and precipitating ſucceſſively, while you can find bodies exceeding each other in degrees of relation to the diſſolving menſtruum, whether aqua fortis or any other. From this example, it is clear, even to thoſe unacquainted with chemiſtry, that there does exiſt a particular, as well as a general attraction. It is alſo as evident, by a multitude of chemical operations, that, when ſubſtances attracting each other unite, if the attraction be in the greateſt degree, they generally loſe their ſolvent power, of conſequence their cauſticity. And here, it ſhould be well noticed, this laſt quality is nothing elſe, than a great tendency to union with different ſubſtances, which, when ſaturated by their combination, is in general almoſt totally loſt. If the affinity be in the ſtrongeſt

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* This experiment might be coverted to bad uſe in regard of the coin.

degree; if only in a weak degree, the cauſticity, or tendency to union, which ſhould be conſidered as the ſame thing, is only obtunded, but not deſtroyed. Of this we ſhall give an example.

EXAMPLE II.

Take alkaline ſalt; add to it acid of vitriol, until it is ſaturated. From the union of theſe two, although either of them, before combination, had the moſt intenſe cauſticity, a ſalt is formed, (tartar vitriolated) of little or no acrimony; of which a man may take an ounce without prejudice; although the ſame quantity of the vitriol, before its junction, with the alkaline ſalt, would be a ſufficient doſe to poiſon a number of people; but, when ſaturated with the ſalt, it becomes neutral, and innocent, being only diuretick, or mildly purgative, for which intention it is often uſed in medicine.

EXAMPLE III.

Put a ſpoonful of oil in a glaſs of water, they will not at all incorporate: Even, if ſhook together, the oil will ſeparate, and float at top.

EXAMPLE IV.

Put ſome ſtrong lee, made with cauſtic alkali, and ſome oil together; they readily unite, and form a ſolid maſs, common ſoap. Add water to this, the ſoap eaſily diſſolves in it. Here you ſee two bodies refuſe to join, the oil and water; one of them however joins with a third; and by the intervention of that one, combines with the one it firſt rejected. The alkali appears here like a common friend, that brings about a reconciliation between two enemies. You may again diſunite the oil and the alkali, by any ſubſtance that has a nearer relation to the alkali, than the oil has: This, all the acids have. Add, therefore, any acid you pleaſe to the ſolution of ſoap and water, the alkali will quit the oil to join with the acid, and the oil will float at top; by which proceſs the ſoap is decompoſed. In the union between the cauſtick alkali and oil, in making ſoap, the junction is not of the moſt intimate kind, as they can be again ſo eaſily diſunited, by the addition of any acid, as already deſcribed. Therefore, according to what has been already advanced, the alkali's tendency to union, not being completely ſatisfied, retains a great part of its acrimony, or ſolvent power. For which reaſon, ſoap is found to be the moſt commodious ſubſtance for waſhing linen, as it eaſily diſſolves the greaſe, and dirt, which is not in a ſtate of great adherence:

But, where it is, as in unbleached linen, it would be ineffectual. For, in the grey linen, the native oil of the plant is ſo intimately combined, that, to extract it properly, it requires all the ſolvent virtue of the pure alkali ſufficiently diluted. Having premiſed ſo much on olective attractions, in order to give ſome ſcientifick ideas of the queſtion, let me be now allowed for the ſame end, to ſay a few words on the nature of aerial acid; as being acquainted with both, is the beſt method I can conceive of making the proofs of my propoſition clear: That forbidding the uſe of lime, through lees in bleaching, is an unfrugal ſuppreſſion of its alkaline ſtrength, and unproductive of the end propoſed. But before treating of fixed air, as it is ſo univerſally diffuſed through the atmoſphere, I ſhall beg leave to ſay a few words on the latter.

Except children, who have not as yet made uſe of their reaſon, or men who are, in that reſpect, always to remain children, either from the weakneſs of their intellects, or want of education, there is none but muſt conſider the air, as a material heavy ſubſtance. From our birth we are plunged in this fluid, doomed to live at the bottom of an ocean of air, like fiſh in the bottom of their element. The man, who reflects at all, muſt pay ſome attention to what intereſts him ſo much, that he can live but a few moments without. Yet, tell the uninformed multitude you can weigh air; that every cubic inch of a man's body ſuſtains the preſure of twelve pounds of air; of courſe, the whole body of a middle-ſized man more than twenty thouſand pounds weight; he only laughs at the aſſertion as ridiculous; although he every day ſees the ſame air put in motion tear up trees by the roots, throw down houſes, &c. he ſees the water riſe in the pump thirty feet, without perceiving the cauſe to be the ſuperincumbent weight of the air on the ſurface of the well, in which the pump is fixed. He ſees one mill turned by a ſtream of water, another, as large and weighty, by a current of air; yet he denies gravity to the one, and allows it to the other. He perceives the weight of the atmoſphere ſuſtain a column of mercury, of equal baſe, about twenty-eight inches in the barometer, which, beſides giving the weight of the atmoſphere, and indicating its variations, has been uſed of late by philoſophers as a means of meaſuring the height of the greateſt mountains; yet theſe overgrown children ſee theſe various phenomena paſs before their eyes without being excited to farther enquiry; like the New Zealander * in his canoe, who could let the Endeavour paſs by him unnoticed, intent only on his prey on which he relied for preſent ſubſiſtence.

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* See Captain's Cook Voyage to the South Sea.

But,

But, the air, with reſpect to its gravity, does not come within my deſign, having to conſider it in another light, as a heterogeneous fluid, being mixed with all that aſcends from the earth in form of vapour, or exhalation, from animals or vegetables. The rivers that empty themſelves into the ſea, return for the moſt part through the air, diſtributing, as variouſly determined by the winds, in dew and rains fertility to the lands. From the ſea, the ſalt, being a heavy body, does not aſcend with the watry particles; therefore, by this operation of nature, the ſea-water is diſtilled and purified; and among the late inventions, that of ſweetening ſea-water by diſtillation, in imitation of nature's proceſs, deſerves our particular notice.

But, among all the different impregnations the air receives, there is none ſo general, as that from fixed air, or more properly aerial acid. This brings me directly to the proof of my propoſition, that not mixing lime with pot-aſh, in bleaching linen, is an unfrugal ſuppreſſion of its ſtrength. For this purpoſe, it is neceſſary to recall to memory what has already been advanced on elective attractions; and that, when ſubſtances, which attract each other, unite, according to the intimacy of their junction, they loſe their ſtrength, or acrimony.

Both alkaline ſalt, and calcareous * earth, or lime, are eſſentially from their own nature cauſtics: but neither can be long expoſed to the influence of the atmoſphere, without loſing in a certain degree their cauſticity. The atmoſphere, being replete with fixed air, between which and theſe ſubſtances there exiſts an affinity, but its affinity to the calcareous earth being the ſtronger, it obtunds all its cauſticity; whereas the alkaline ſalt, by forming an union with fixed air, loſes but about half its ſtrength. When the calcareous earth is expoſed to the action of a ſtrong fire, the aerial acid, by which it was ſaturated, is expelled; and the lime regains its acrimony, and becomes quick-lime. If, in this ſtate, it is mixed with a ſolution of mild alkaline ſalt, the lime, having a greater affinity to the fixed air than the ſalt has, it attracts the fixed air from the latter; by which proceſs the alkali gains double ſtrength to what it had.

EXAMPLE.

Take ſome lime-water, add to it ſome mild alkaline ſalt, the water becomes immediately turbid, and the lime falls to the bottom, and becomes inert; but while the cauſticity of

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* Calcareous means any ſubſtance convertible into quick lime by the action of fire.

the lime is loſt by this proceſs, that of the alkali is doubly increaſed. This change has happened, as already mentioned, by the lime's imbibing the aerial acid from the alkali; the acid having the greater affinity to the former. By this means the alkali gains double ſtrength, as a ſolvent of many ſubſtances, particularly of the oily kind. But, as the lime, in this experiment, falls to the bottom in a bland ſtate, and no longer miſcible with water, more than powdered chalk, there is no poſſible room left to imagine, it could, in that ſtate, be hurtful to linen, the contrary being ſo clearly demonſtrated. Then, the whole queſtion naturally turns on the one point: Whether it is more detrimental to the linen to uſe the alkali in the cauſtic, than in the mild ſtate? I apprehend the plain anſwer to the queſtion is this: That according as the alkali is weakened, and loſes its ſolvent power, by being ſaturated with the fixed air, ſo much the more it will require to make leys of the neceſſary ſtrength for bleaching; but the purer and more cauſtick the alkali is, the leſs quantity is required. I muſt confeſs, I think it a ſimilar queſtion, as if a man ſhould be aſked, which was ſtrong or weak ſpirits the better to make punch. He would undoubtedly anſwer, he could make it equally well with either, by proportioning the water to the ſtrength of the ſpirit: But, if he could, by a cheap ingredient make the weak ſpirit equal to the ſtrong, it would not be wiſe to object to the method, for fear the punch ſhould be too ſtrong for his ſtomach; as to remedy this, he need only dilute with more water; and, by this œconomical contrivance, the one bottle would go as far as two. So the bleacher can make his ley, as weak, with the cauſtick alkali, as with the mild, by putting only half the quantity. The importance of the ſubject merits the minuteſt diſcuſſion; as the act of parliament in queſtion, if my ideas be right, would be, ſo far, a ruinous meaſure to the ſtaple manufacture of the kingdom, as clogging it with double expence, without any good accruing. The premiſes I ſtrove to eſtabliſh on the valid evidence of experiments: and, if the premiſes be juſt, which I ſubmit to the candour of better judges, I think I am well founded to conclude from them, that the hindering the admixture of lime with pot-aſh, in bleaching, is an unfrugal ſuppreſſion of their ſtrength, and unproductive of the end propoſed by parliament.

However, it is alleged, that our linens are ſo abuſed in the bleaching, that the Iriſh linen manufacture is in danger of falling into diſrepute, to the great injury of our trade. I readily allow that may be the caſe; and our parliament have ſhewn conſummate wiſdom in their political capacity, to make ſuch a law as to them ſeemed beſt calculated to prevent the evil: but, for want of referring the matter, for examination, to chemiſts by profeſſion, I muſt humbly preſume, according to the principles laid down, they have miſtaken its ſource, and not applied the ax to the root. For, if it be conſidered, that it is a general practice in bleaching, to ſteep the linen twenty-four hours in water ſoured with oil of vitriol, this latter proceſs, upon proper examination, would be found more adequate to the effects complained of, than any other uſed in the various manipulations linen undergoes. I only offer my thoughts as a phyſician, unacquainted with bleaching by practice; but, from my profeſſion, neceſſarily verſed in the doctrine of cauſticks; but, to elucidate the ſubject, as far as in me lay, I made this trial: I took oil of vitriol and cauſtick alkali, put each in a ſeparate glaſs veſſel; I diluted each with twelve parts water, and immerſed a ſmall piece of linen in each glaſs. The reſult was, that the piece immerſed in the vitriolated water was acted upon through its whole ſubſtance, and came in bits when pulled between the fingers: the bits ſteeped in the cauſtick ley was infinitely leſs damaged.* The force of the vitriol ſeems, therefore, to be equally determined to the whole ſubſtance of the linen; while the ſolvent power of the alkali is chiefly confined to the oil of the plant,

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* This example is brought merely to ſhew their comparative degree of cauſticity, which could not be ſo well known if they were greatly diluted, at leaſt, it would not be ſo immediately evident.

For, although the vitriol acts on oil before dilution, whether it ſuffers ſome decompoſition on being mixed with water, as the great heat might indicate, or whether it is owing to its intimate combination with the water, it has no apparent action on the oil after dilution; which ſhews it muct act on the whole ſubſtance of the linen together, deſtroying it in toto; whereas the alkaline acrimony ſpends itſelf on the oily matter.

The mixture of quick lime with the alkali is abſolutely neceſſary in making ſoap, as without it, it would not unite intimately with the oil: It muſt appear from this that the method which makes its ſolvent power and attraction to greaſe ſtronger ſhould be of great benefit to green linen, at leaſt in the firſt boilings; the ſoap-boiler takes one part of lime, two parts of alkaline ſalt, which he boils together for an inſtant in twelve times their weight of water; after filtering, it is boiled down to a proper conſiſtence, until the full of a viol, holding an ounce of water, will contain of this lye an ounce and two ſcruples: this ley, mixed with double its quantity of oil, ſoon forms a hard ſoap. But, if in the proceſs of making ſoap, the fixed air was not previouſly extracted from the alkali, its ſolvent power would be ſo weakened by its mixture with the fixed air, that it could unite but very imperfectly with the oil, and never compoſe ſoap of any tolerable conſiſtence.

This is confirmed by M'Quere: He ſays, "Il eſt abſolument neceſſaire de rendre "cauſtique par la chaux l'alkali fixe qu'on "veut combiner avec l'huile pour en faire de "ſavon ſans quoi la combinaiſon ne ſe fai- "roit pas ou ne ſeroit que tres imparfaite a "cauſe de gas uni naturellement aux al- "kalis lequel diminue beau coup leur action "diſſolvante et que la chaux leur enleve "completement." It is abſolutely neceſſary to render cauſtick by lime, the fixed alkali that is to be combined with the oil, in order to form ſoap, without which, the combination would not take place, except in a very imperfect manner, on account of the fixed air, naturally united to the alkali, which ſubſtance greatly diminiſhes its diſſolvent action, and which is entirely abſorbed by the lime. You will find it again confirmed by the ſame author, that the alkali is improved in its ſolvent power by its mixture with quick lime, and that the lime, by this proceſs, becomes an inert effete ſubſtance, and of conſequence incapable of exerciſing cauſticity, or doing, by that means, any injury. His own words will carry the ſtronger conviction: "Tous "les alkalis eprouvent des echangements "conſiderables lers quils ſont traites avec de "la chaux vive leur cauſticite leurs action "diſſolvante leur fuſebilite leur de liquiſ- "cence de viennent plus forte & plus "marque: de lautre coté les alkalis non "cauſtiques, font eprouver a la chaux "vive de changements qui ne ſont pas

" moins conſiderables en ce qu'ils lui en le
" vent touteſſes propretès de chaux vive &
" la retabliſent dans ſon premier etat de ſim-
" ple terre calcaire non calcine."

All the alkalis undergo conſiderable changes when treated with quick lime; their cauſticity, their diſſolvent action, their fuſibility, their deliqueſcence, become more ſtrong and marked. On the other hand, the mild alkalis make the quick lime undergo no leſs conſiderable changes by depriving it of all its properties of quick lime, and reſtoring it to its priſtine ſtate of ſimple calcarreous earth.

Anderſon, in his ingenious Treatiſe on Agriculture, gives the following cautionary advice to farmers, whoſe horſes may be in danger of having their hoofs burned, by threading on the lime, when a great quantity is laid out on land which the horſes are to plough. Mr. Anderſon affirms, the beſt method to prevent any inconvenience of this ſort, is to ſpread the lime, when in its powdery ſtate upon the field, as evenly as poſſible, and allow it to lie in that ſtate for ſome time before you begin to plough it; if the lime has been in fine powder, it will have become perfectly effete in a week or ſo, after which time it will be as little corroſive as any kind of common earth, and horſes can work through it with perfect ſafety, becauſe the cauſtick lime had time to re-abſorb its fixed air. I have brought this intelligent farmer to bear teſtimony to the doctrine I have all along advanced, and, I dare preſume, no chymiſt in Europe would controvert.

Certainly the wiſdom of the legiſlature could not be directed to a more important object, than by proper regulations *obviating* the cauſe of complaint againſt our linens, on account of being abuſed in the bleaching, and by that means retrieve the credit of our ſtaple manufacture in foreign markets, and not by ſupineneſs or neglect in this reſpect, ſuffer our rivals in trade to derive advantage from its diſrepute. But is it reaſonable to imagine that a point, chymiſts by profeſſion, might find difficult to determine with a tolerable degree of certainty, could at once become evident. It appeared from experience the linens were damaged, but the ſource of the evil could not be ſo apparent as the fact, as it depended on a knowledge of chymiſtry, and we are not to conſider the Members of Parliament, at leaſt in their ſenatorial capacity, as verſed in chymiſtry, or aſſembled to diſcuſs its laws; therefore, ſuppoſing an error in the Linen Act, which I ſhall not take upon me abſolutely to affirm, it neither derogates from the wiſdom of the member who introduced the bill, or of thoſe who concurred in its propriety; but its repeal would reflect double honour, as it would ſhew the *moſt* candid temper, and the greateſt openneſs to conviction.

tion. The corroding quality of quick lime muſt be the firſt to ſtrike, and offer itſelf to the imagination as ſo powerful a cauſe, that it did not ſeem neceſſary to look for any other.

But gentlemen did not advert ſufficiently to the nature of ſpirit of vitriol, which is by far a more powerful cauſtick than lime in its moſt active ſtate; and I am confidently informed that linen, is left to ſour (as it is termed) in water impregnated with it for twenty-four hours. And ſince I conceived the idea of publiſhing theſe remarks, I enquired of many bleachers, which they thought the moſt detrimental proceſs to the linen, the mixture of lime through pot-aſh, or the proceſs of ſteeping the linen ſo long a time in the vitriolated water? and I can aver they unanimouſly agreed in the ſame opinion, that the linen was certainly more liable to injury from the ſouring proceſs, than any other it underwent; their phraſe was, that it quite ſcalded the linen. If my ideas, and their experience, upon farther enquiry, meet, and that upon a more mature deliberation it may appear to be the caſe; there is no doubt but gentlemen of liberal minds, always open to fair conviction, will give the matter a more thorough inveſtigation; and if by this means, and experiments, on a more ample ſcale than it was in my power to make, my ideas are confirmed that they will be as ready to reverſe the act againſt lime, and frame a new one againſt the uſe of vitriol, as they were to make the preſent one, to prohibit the uſe of lime, in either caſe being equally biaſſed by the good of the nation; for my own part I am not poſſeſſed of the vanity to imagine, that any thing I can ſay, can flaſh conviction on the mind, at once, my utmoſt expectation ſhall be anſwered if it ſo far gains as to throw ſo much doubt on the propriety of the act, as to occaſion its being re-conſidered and receive fair diſcuſſion, and certainly the greatneſs of the object, merits the minuteſt attention.

As the proſperity of the nation is ſo eſſentially involved in whatever concerns its linen trade: And as the linen manufacture depends ſo much, on a cheap and conſtant ſupply of aſhes: The yearly allowance of four thouſand pounds for the encouragement of making it at home for the bleachers uſe, and for promoting the cultivation, and diſcovery, of ſuch vegetables as afford the greateſt quantity of alkaline ſubſtance when burned, muſt be looked on as a meaſure founded in the greateſt political wiſdom, and tending to the encreaſe of national wealth.

The following remarks may be of uſe in that reſpect: Theſe plants which contain the greateſt quantity of acid upon being analized, by any other chymical proceſs, but that of combuſtion, generally produce in proportion a greater quantity of alkaline ſalt by incineration.

This phenomenon muſt naturally induce an aſſent, that this acid is ſome way a component ingredient in the formation of alkali; Macquers thinks it may be compoſed of the vegetable acid, which during the combuſtion of the plants unites after a particular mode to its earth, and inflammable principle. And it is a matter of fact, if theſe plants ſhould by a prior diſtillation, or extraction of their eſſential ſalt, loſe a part of their native acid, they will give a proportionably leſs quantity of alkaline ſalt upon incineration. From which the ſame induction follows, that the acid is eſſentially neceſſary in the formation of the alkali; and this opinion ſtill gains additional weight, from the conſideration, that theſe extracts, which contain the moſt of the acid of the vegetable, from which they are taken, afford the greateſt quantity of alkaline ſalt by combuſtion; and that the concrete acids, as tartar, cream of tartar, are almoſt entirely converted to fixed alkali, by calcination, that oily ſubſtances, which have little acid, leave ſcarce any veſtige of alkaline ſalt after their combuſtion.

That the ſame happens, in regard of plants, whoſe acid is volatile, and eaſily diſſipated. And of thoſe, from which no acid can be got by diſtillation, all theſe phenomena, collectively conſidered, ſeem to put this opinion on a very probable footing, and to warrant a ſtrong ſuppoſition, that fixed alkali owes its origin chiefly to the vegetable acid. It is on this account that vegetable ſubſtances that have been long macerated in water, or that have undergone decoction, are incapable of producing alkali: alſo wood long immerſed, or floating in water, is thereby rendered unproductive of alkali, becauſe its acids and eſſential ſalts are diſſolved and waſhed away by the water, which acids and ſalts, are the principal ingredients that conſtitute the alkali. Another proof is, that vegetables when they are not timely uſed, but left neglected in a heap after being cut, until a putrefaction enſues, if burned afterwards, they do not produce the leaſt alkali, tho' before putrefaction, they ſhould be ever ſo rich in this ſubſtance. There is no doubt, however, that there are not wanting reaſons which may be aſſigned, for upholding the doctrine of ſome chymiſts, who imagine the alkali to have exiſted already, formed in the plant, anterior to combuſtion. The facts ſtrongeſt in favour of this opinion, ſeem to be the experiments made by Margraff and Rouel, by which they have ſhewn the pre-exiſtence of alkali, in cream of tartar, before combuſtion; this is done, by joining it with mineral acids, and from their junction with the cream of tartar, obtaining neutral ſalts, ſuch as ſhould reſult from the union of the acid employed, with the vegetable alkali. The ſame neutral ſalts are alſo obtained, ready formed from ſome plants; which is certainly a proof of the exiſtence of an alkali in the plant anterior to combuſtion, and that of conſequence, alkaline ſalt is not always a creature of the fire, but may naturally exiſt in the plant; but although it may be allowed to exiſt naturally in ſome plants, prior to incineration, this will by no means deſtroy the idea of the greater part being formed merely by the proceſs of combuſtion; by which, acid, earth and phlogiſton may be modified and *combined* into this ſubſtance, eſpecially as the beſt chymiſts agree, theſe are the conſtituent principles of fixed alkali. So that the alkali, in all appearance, may be formed by nature or by art.

It is a fact well known, from experience, and an attention to which would ſeem to coincide with and forward the laudable intention of the act mentioned, that the ſame plant may prove rich of alkali in one kind of ſoil, and afford very little in another. And, as it has not as yet been aſcertained, by proper experiments, what ſoils are beſt adapted to the different ſpecies of plants that are burned for their *alkali*, to make them yield the greateſt quantity there is great room for farther reſearch in this line; and it muſt be by ſome time and experience, a certainty can be arrived to, by which we can preciſely know the fitneſs of ſoil for the different ſpecies, in order to obtain a profitable product from their combuſtion. By acquiring this knowledge, and an acquaintance with the plants that *cæteris paribus* yields moſt alkali, to which, I flatter myſelf, the hints above given may, in ſome ſort, conduce, joined to the knowledge of the quickneſs of their growth, the facility of their cultivation, the Honourable Truſtees of the Linen Board would have a better criterion to direct them, in holding out encouragement by the diſtribution of premiums, as they would have a clear view of the nature of their object, and be leſs ſubject to deviate from the moſt direct path to its attainment.

But the grand *deſideratum* in this reſpect would be, to diſcover ſome method of decompoſing ſea ſalt, by ſo cheap a proceſs, that its alkaline ſalt might be obtained at ſo low an expence as to ſuperſede the uſe of any other.

As the Soda, or mineral alkali, would anſwer moſt purpoſes better than the vegetable, it would do at leaſt equally well in the linen, and anſwer much better in the glaſs manufactory.

Mr. Margraff and Du Hamel have attempted the decompoſition of ſea ſalt thro' the medium of phlogiſton; but, unhappily, their endeavours have hitherto proved abortive.

The Royal Academy of Sciences, at Paris, have offered a premium of 2400 livers to the perſon that ſhall find out the eaſieſt and cheapeſt proceſs for decompoſing ſea ſalt, and extracting the alkali, that ſerves as its baſis, in a ſtate of purity, free from acid, or any other combination, provided the value of this mineral alkali, does not exceed the price of that which is procured from the beſt foreign Soda. There is not any nation this diſcovery ſhould intereſt more than our own; and if the Board could ſee it in this light, and think proper to hold forth requiſite encouragement, it would be injurious to our national repute, not to ſuppoſe there may as capable men be found in Ireland, to ſolve the knotty point, as in any other country; and there is not a more indiſputable political axiom, than to have many honours in reſerve for thoſe who do national ſervices; it raiſes emulation, cheriſhes publick merit, and inſpires every one with an ambition to promote the good of his country.

They give the name of Soda to the aſhes of maritime plants, which they burn in thoſe countries bordering on the ſea. Theſe, according to Maguere, are of different degrees of purity, according to the country they come from. He mentions thoſe, as the beſt, that come from Alicant, or Languedoc; but what comes from Normandy is of a much inferior quality. The Sodas contain the mineral alkali, which is of extenſive uſe in bleaching, making ſoap, and in the glaſs foundery. But as the Sodas and pot-aſh contain a great deal of heterogeneous matter, as neutral ſalts and earth, it would be a matter of ſome importance, and not unworthy the notice of the Linen Board to take ſome cognizance of the caſe, and have their reſpective degrees of purity aſcertained, as well as the nature of the caſe may admit of. The undertaking would, no doubt, be laborious to the chymiſt, but it might furniſh the manufacturer with very neceſſary knowledge on the ſubject. It would enable him more exactly to determine the ſtrength of his lyes, and at the ſame time it would inform him of the difference of the value of each kind.

Had it been my intention to be more diffuſe, it is evident the ſubject would afford ample occaſion, as I have hardly ſkimmed the ſurface of things, which would require the cloſeſt inveſtigation, and a minute diſcuſſion ; but, unwilling to take a great deal of pains in vain, being dubious, in what light my efforts ſhould be viewed by the publick, whether what I have offered for conſideration, and the ideas I have thrown out, ſhould be conſidered as rational and founded on juſt grounds, or *vice verſa*. I thought it moſt prudent, in the interim, not to venture on an extenſive plan, but rather impact the heads of theſe matters into as narrow a compaſs

paſs as poſſible, to try firſt the publick opinion, before I ſhould launch into further diſquiſitions, on matters that might not appear in any manner intereſting to others, while to me they ſeem to be of importance to the commonweal; I therefore, for the preſent, take my leave of this part of my taſk, and proceed, according to my plan, to make a few remarks on agricultural knowledge.

SECTION II.

THE celebrated Robertſon, in his Hiſtory of America, ſays, the effects of human ingenuity and labour are more extenſive and conſiderable than even our vanity is apt at firſt to imagine. When we ſurvey the face of the habitable globe, no ſmall part of that fertility and beauty, which we aſcribe to the hand of nature, is the work of man: his efforts, when continued through a ſucceſſion of ages, change the appearance and improve the qualities of the earth. Beſides, by the aſſiſtance of art, nature is not only embelliſhed, and the earth made more productive of ſubſiſtence for the human and brute creation, but it is alſo rendered more wholeſome and friendly to life. The experience of ages confirms what the ſame great hiſtorian farther advances in reſpect of uncultivated regions, in the following lines: When any region lies neglected and deſtitute of cultivation, the air ſtagnates in the woods; putrid exhalations ariſe from the waters; the ſurface of the earth, loaded with rank vegetation, feels not the purifying influence of the ſun; the malignity of the diſtempers natural to the climate encreaſes, and new maladies, no leſs noxious, are engendered.

This deſcription applies only to rude nature, in her moſt wild and unaſſiſted ſtate. But in Ireland, although the ſoil is ſo far from arriving to its moſt perfect ſtate of improvement, that, on the contrary, in ſome parts, very little has been effected towards its melioration; yet, there is ſcarce any part but has been more or leſs changed by the activity of man from its original rudeneſs, and cannot conſequently come directly under the above deſcription. But we are ſo far behind in the cultivation of our land, in reſpect of the perfection it might be brought to, that this work is ſtill in its infant ſtate, and leaves room ſtill for vaſt exertion.

I ſhall now endeavour to ſhew that an acquaintance with the principles of chymiſtry is the ſureſt road to arrive at farther improvement in agricultural knowledge. Much has been written, in this line, on the utility of draining, ditching, planting, hoeing, on the difference between the broad-caſt and drilling huſbandry, the proper ſucceſſion of crops, ploughing, fallowing, &c. Theſe all have their uſe; but more advantage has accrued to the tillage of barren lands from the lime-kiln, than any method hitherto deviſed. Vaſt tracts of unprofitable land have been reclaimed in Ireland by lime and marl, which could be meliorated by no other means. But the burning of lime comes immediately within the verge of chymiſtry. This ſcience ſhews us the true nature of calcareous earths;

earths ; and by it we are enabled to obtain a theoretical knowledge of their manner of operating ; by which, barren lands, inſtead of heath and moſs, become covered over with luxuriant verdure. Land, according to my conceptions, by the admixture of foreign matter, may be improved in four ways : Firſt, by edulcorating its auſtere juices ; ſecondly, by dividing and comminuting the earthy particles by an effervеſcent motion ; thirdly, by attenuating the oleaginous particles, and reducing them to a ſaponaceous ſtate ; fourthly, by affording vegetable food. And nothing has been diſcovered hitherto that fulfils theſe four intentions better than lime or marl.*

To evince the truth of the firſt propoſition, that lime edulcorates the auſtere, or acid, juices, we have only to recur to experiment, and, inſtead of argument, give facts. Take acid of vinegar, of vitriol, ſea-ſalt, nitre, or any other ; add to them a ſufficient quantity of lime, and you immediately deſtroy their acidity.

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* It may be of uſe to remark, that marl is eaſily burned into quick lime, as many places that abound with marl are far from limeſtone quarries ; and, by this not being generally known, the inhabitants of ſuch places are often at a loſs for lime, when they might ſo eaſily ſupply themſelves. The lime produced from marl is of an unctuous feel, and free from grittineſs, which might make it preferable for ſome purpoſes.

That, in barren lands, there is a prevailing acidity, is a common opinion among farmers : they even find the graſs on ſuch perceptibly ſourer, than on richer grounds. However, the matter, no doubt, merits cloſer examination than I had opportunity to give it : but, upon the ſuppoſition, that lands may really ſuperabound with the acid principle, to the injury of its fertility, it is at once apparent, from the ſuſceptibility of attraction between the lime and acids, what a ſovereign corrector lime muſt be in that caſe. It is no objection, that lime, laid on land for its reclaimation, is generally ſaturated with fixed air ; becauſe any of the other acids, having a greater affinity to the lime, the fixed air will be expelled by them ; and, from the efferveſcence conſequent on their mixture, I deduce the proof of my ſecond propoſition : that earth is fecundated by an efferveſcent motion. The cauſe of efferveſcence is known to be nothing elſe, than the elaſtic force of a fluid regaining its liberty. In the lime, the fixed air is liberated by the acid ſuppoſed to be in the earth ; and, reſuming its expanſive power, it burſts through every oppoſition that impedes it in its ſtruggle to be free: it breaks through the earth, bubbles through the water, and other liquors.*

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* The accumulation of fixed air in ſubterraneous places, by its efforts to get free, is thought to be often the cauſe of earthquakes.

But, as the acid particles may lie in the earth in an inviſcated ſtate, ſheathed with unctuous and other ſubſtances, their ſudden union with the lime is hindered, which occaſions a ſlow ſwell and ferment. By this means, like barm in dough, by the gradual fermentation, the earthy particles are comminuted, and brought to the fineſt ſtate of diviſion, which is the moſt favourable condition land can be in for vegetation; and, no doubt, a quantity of fixed air may be retained in the earth, in a ſtate of ſlight adherence, ready to enter the plants, and by this means alſo aſſiſt their nutriment: vegetables, on their analyſis, afford a vaſt quantity of fixed air; which proves it to be a principal ingredient in their compoſition: therefore efferveſcence may be a cauſe of fecundity to land, by dividing its particles, and ſupplying a ſtore of fixed air.

For the proof of my third propoſition, I refer to Example IV. and all that has been already ſaid on the affinity between oily and alkaline ſubſtances. That the lime affords vegetable food, is apparent; as the earth, not only of vegetable fibres, but even the bones of animals, are, by late experiments, found to be of the calcareous kind: And this is, I imagine, ſufficient proof to lean my fourth propoſition on.

I might enter here on the diſcrimination of the various kinds of earth, as laid down by chymiſts, and give a detail of the characteriſticks of the argyllaceous, the vitireous, the calcarious : But, although it would not be foreign to the ſubject, yet, as it would lead into prolixity, contrary to my deſign, which is, not to take up the ſubject in order to give it a full diſcuſſion, but merely to glance upon it, with a view to ſhew the advantage of ſcientific knowledge, I decline any farther enlargement on that head : And proceed to the conſideration of a ſubſtance that might eventually prove a new ſpecies of manure, and merit trial. I conſider phlogiſton as a more powerful obtunder of acidity than lime ; at leaſt, it has a greater affinity to the mineral acids. Therefore, where the acid principle abounds to the injury of the land, it might effectually correct it. I conſidered, that phlogiſton is generally found to be a component part in moſt vegetables ; and that they emit ſo much flame in analyſing, as to appear chiefly made up of it.

Setting off from theſe data, I muſt ſuppoſe phlogiſton may, like lime, enrich land in two ways : Firſt, by deſtroying acidity. Secondly, by affording vegetable food, as being a component ingredient. Stahl's famous experiment, by which he ſucceeded in making ſulphur, by combining the inflammable matter with acid of vitriol, is of itſelf ſufficient to ſhew the great attraction ſubſiſts between it and the acids : And, as I have juſt now obſerved, by combuſtion we have a ſufficient proof, that phlogiſton is a chief ingredient in the compoſition of vegetables. I know, the celebrated Swediſh chymiſt Scheel's opinion is repugnant to this theory of combuſtion, inculcating, that it is the air ſuffers decompoſition in this proceſs; and that its phlogiſton, running into union with an acid in the plant, by that means ſupplied flame. But, as his ingenious hypotheſis has been refuted, and is fallen to the ground, I ſhall take no farther notice of it, but proceed on the received notion, that phlogiſton conſtitutes a component part of the vegetable. Taking this for granted, and keeping always in view its being a ſovereign corrector of acidity, it ſhould biaſs the mind to a belief, that ſubſtances containing phlogiſton, in a ſtate it can eaſily mix with other matter, are proper for the purpoſes of manuring land. Let us now conſider the ſubſtances likelieſt to produce this effect, by abounding moſt with the inflammable principle in the moſt miſcible ſtate.

Of all bodies containing phlogiſton, charcoal ſeems the beſt calculated to anſwer the purpoſe. I conceive, that the great plenty of bog in Ireland would afford ſufficient materials for turf-coal, where no other ſpecies of manure can be got ; and, that, of all kinds of coals, this, when properly burned, being of a looſe friable texture, would beſt anſwer the end. Then, what I would propoſe for trial is, that turf ſhould be cut, and dried in the uſual way; that it ſhould then be burned into coals, as ſmiths prepare it for the uſe of the forge: They ſet fire to a clamp of turf, then cover it over with wet mold; by which operation, the phlogiſton of the turf is half ſet at liberty, and, of conſequence eaſier communicable to bodies in contact. This is a fact ſufficiently known to chymiſts, as in the reduction of metals, by the aſſiſtance of charcoal, the phlogiſton is communicated by the charcoal to the metallic calx. In this inſtance, it is certain the aid of ſtrong heat is required.

What places this matter in a more favourable light, and ſeems to eſtabliſh it on a more ſolid baſis than mere conjecture, is, that ſoot, which is a kind of charcoal, has been already tried on land, and has proved to be a ſtrong manure. As for the operation of digging, or ploughing land, then burning the ſods, it differs, tota facie, from my propoſal; as in this method the ſods are burned to aſhes. But, in reducing turf to charcoal, there will be infinitely a greater ſaving, than when reduced to aſhes; as the turf loſes little of its volume by the former operation: So little, that, I believe, double as much turf, as is expended in burning any quantity of lime ſtone, would go as far in reclaiming land, as the lime burned by it; whereas by burning the turf for its aſhes it would require an immenſe quantity of turf, a large rick of which would not I ſuppoſe leave as much aſhes as would manure a few perches: Beſides aſhes, being deprived of phlogiſton, conſtitutes a different ſpecies of manure from charcoal, which is replete with that ſubſtance. But as experience is the only deciſive argument in theſe matters, and that I had no opportunity of having recourſe to this infallible teſt, I ſhall quit this article, having too long dwelt on a dubious ſubject.

As it may be of ſome utility to country gentlemen, to be acquainted with the beſt teſt for trying calcarious earths, and finding out their comparative degrees of purity, I ſhall give the moſt approved method, for ſuch trial, with which I ſhall conclude this ſection.

Mr. Anderſon adviſes ſuch as may diſcover a new quarry of lime-ſtone, and who wiſh to aſcertian with certainty its real value, before they put themſelves to any expence about it, to employ the following eaſy and accurate method.

All calcarious matters are capable of being diſſolved in acids, and as no other earthy matter can be diſſolved in them, it follows that if a ſufficient quantity of acid, is poured upon any body that contains calcarious matter, this matter will be diſſolved, while the others are left behind, and the proportion of each body may be accurately aſcertained.— To try therefore the exact value of lime ſtone or other calcarious matter, take a quantity of aqua fortis, or ſpirit of ſea ſalt, previouſly a little weakened with water, put it into a glaſs or earthen veſſel, add to it by little and little, a known quantity of the matter you mean to examine, which muſt be previouſly dryed and reduced to powder, after each addition ſuffer the violent efferveſcence that will enſue to abate before more is added, when the whole of the powder is put to the acid and the efferveſcence has ſubſided, ſtir it about ſeveral times, with a piece of tobacco pipe, and allow it to remain for ſome time, that the acid may act upon every particle of the matter, and thoroughly diſſolve it: to be certain there has not been too little acid, put a few drops of freſh acid to the ſolution, which will excite a freſh efferveſcnce, if the whole is not fully diſſolved; when no change is produced by this addition, it is a certain proof that the whole is already diſſolved; take then a piece of filtering paper, thoroughly dry, the weight of which is alſo known, put it in a glaſs funnel, put the whole of the ſolution, with the matter that may have ſubſided into this funnel, and allow it to filter ſlowly, when the fluid part has thus ſtrained off, fill up the filter again with pure water to waſh off the whole of the ſaline parts from the reſiduum, add water in this manner, until it comes off without any ſaline taſte, ſuffer it then to drop off entirely, dry it thoroughly, and weigh the paper with its contents, the difference between which, and what the powder and paper were at the beginning, is the whole weight of the calcarious matter. So that its proportion to the whole maſs, is by this means aſcertained with a great deal of preciſion.—I have frequently amuſed myſelf in the country, by making analogous experiments upon lime ſtone, and marl got in different parts of the country, and have always found a great difference in their reſpective degrees of purity.

SECTION III.

I CANNOT flatter myſelf, that any thing I have advanced merits farther notice, than that lightly touching on an intereſting ſubject, might excite ſome perſon better calculated for it to go to the bottom of theſe enquiries: The entire ſcope of my ſlender attempt being no more than to ſhew the near connection there is between the ſciences, eſpecially philoſophy and chymiſtry, and the various arts; and that encouraging the former, would be the ſureſt means of improving the latter, by furniſhing fundamental ideas.

Hitherto, ſcience, in this nation, has met little encouragement, it has languiſhed along with the conſtitution of the country: But as the latter is now emancipated from all reſtrictions, it is to be hoped the former will keep pace, and adorn the dawn of her glory: Otherwiſe, as an illiterate clown, who would unexpectedly get poſſeſſion of a large inheritance, would only become more ridiculous by his exaltation; ſo a nation, *raiſed by the moſt glorious exertions*, will ſtill appear with a blot in the eyes of Europe, if ſhe ſhould overlook the intereſts of literature. I cannot refrain here from tranſcribing a few lines from an eſſay in the Freeman's Journal of this day's date, November 26th, 1782, as the ſentiments it conveys ſeem to quadrate with my purpoſe: "It is a fact that muſt be diſagreeable to every Iriſhman, that the College of Dublin has, in the production of, I will not ſay great men, but authors of celebrity, has been extremely and notoriouſly deficient. This renders us an object of foreign contempt, and the appellation of ſilent ſiſter, diſgraces our ſeminary among *the Britiſh Univerſities*."

The author, indeed, of a late very ingenious pamphlet on College affairs, influenced, I ſuppoſe, by an excuſable partiality, has been hardy enough to combat this opinion; but the puny catalogue of authors produced by him is no refutation; and, is it not evident that this ſtigmatized ſterility is the natural effect of neglected cultivation: Compoſition is not encouraged in the College, therefore, it is a probable concluſion, that writers will not abound there. Experience juſtifies the deciſion of reaſon.

Beſides, it is worthy notice, that Swift and Goldſmith, the moſt univerſally celebrated of all the writers whom our College educated, and whoſe productions ſhe boaſts as her chief defence againſt this foul imputation, were men who received many diſgraceful marks of College diſapprobation, and were treated as dull and incapable. Was this treatment merited? Or rather was it not a conſequence of the neglect I complain of? Was not application to an unpatronized ſtudy indirectly productive of Academic cenſure. Hence too, if eminence was obtained, ſurely it cannot be imputed to Academic inſtitution. But had the Board of Senior Fellows attributed honours to excellence in compoſition, theſe men would have been as much celebrated in the Univerſity as they were in the world; and they themſelves would have avoided the apparent ſtupidity of contemning the abilities of their moſt ingenious pupils."

Let us now ſuppoſe an Iriſhman ſhould be aſked in any part of Europe, what encouragement was given in his country to learned and ingenious men, had they in it Academies of Sciences, of Belles Lettres, &c. could he hear ſuch a queſtion without a bluſh of conſcious ſhame, as he would ſenſibly feel the honour of his nation involved in the anſwer? The want of ſuch incitements is the more to be regretted, as wherever Iriſhmen meet with them, they ſhew it is not for want of native genius they make no figure at home. Fame and emoluments muſt be looked on as the main ſpring of all induſtry: It ſets the philoſopher to the exerciſe of his pen and talent, as well as the farmer to that of his plough. Hope is as neceſſary to the mind in this reſpect, as the nervous fluid is to the body. The one gives motion to the corporeal frame, the other gives a ſpring to the mental powers.

But are literary ſocieties the beſt means of promoting uſeful and philoſophical knowledge? No doubt the wiſdom and united efforts of ſuch would be the moſt likely means from which we might hope for the happy reſult.

And for this opinion we have the ſuffrage of the greateſt phyſician, perhaps, the world has ever ſeen, the immortal Boerhaave. I ſhall beg leave to quote or inſert his own words: "Literary commerce has conduced much to the improvement of phyſick, when that was facilitated by the inſtitution of public poſts, or conveyances of letters, but much more by experiments made by the invention of various machines, to lay the truth of nature more open to us, and, laſtly, by the inſtitution of learned ſocieties, for the improvement of philoſophy, natural hiſtory, the arts, and phyſick, at London and Paris." But ſince that great man's time, from their apparent utility and eſſential importance, theſe ſocieties have multiplied. There is ſcarce a noted town in Europe but has its academy of ſciences; even the town of Mancheſter has lately eſtabliſhed one; and I look forward with elated hope, and ſee in future proſpect, the time when Ireland after, by inherent vigour and innate magnaminity, having thrown her fetters aſide, and eſtabliſhing her natural rights on a broad and ſolid baſis, ſhall enlarge her views with her freedom, and vie with the moſt conſpicuous nations in promoting, by every encouragement, the intereſts of ſcience and literature in general; when Dublin, as well as Paris or London, ſhall have her academies of ſciences. Let us turn our views to the manner in which theſe ſocieties, in the different parts of Europe, conduct themſelves, and we will have a more convincing proof of their importance in forwarding ſcientific purſuits. For this purpoſe, I ſhall extract from the London Medical Journal ſome of their prize queſtions, as it will give ſome notion of their proceedings.

The Society of Arts and Sciences, at Utrecht, have propoſed the following for a prize of thirty ducats:——Is the planting of trees, in great towns and their environs, ſalutary or hurtful to the health of the inhabitants—Do their exhalations purify or corrupt the air——And what ſpecies of trees do the moſt, or the leaſt good or harm? The diſſertations are to be ſent to Mr. Van Heeſten, ſecretary to the ſociety, before the 1ſt of December, 1782.

The Academy of Sciences at Toulouſe, have propoſed the following for a prize of 100 piſtoles:——To aſcertain the effects which air, or aiery form fluids introduced into, or generated in the human body, have on the animal œconomy?

An Academy of Sciences has lately been founded at Batavia, in the Eaſt Indies; it extends its views to agriculture, commerce, phyſick, natural philoſophy, natural hiſtory, antiquities and morals. The academy has already propoſed the following queſtions in phyſick; the prize to be proportioned to the utility of the diſſertation, but if approved will be, at leaſt, 100 rix dollars.——Quidnam ſit dyſenteriæ ſpecies Indis propriæ, quomodo ea ab Europea differt, quibuſve remediis ſit arcenda, &c.——What ſpecies of dyſentery is peculiar to the Indies, and by what remedies it is beſt cured; and how does it differ from the dyſentery in Europe?

The Royal Academy of Sciences at Rouen, has propoſed the following queſtion for a prize of 300 livres:——In what degree, and in what manner, can we depend upon magnetiſm, or electricity, either poſitive or negative, in the treatment of diſeaſes?

I might extract as many as would fill a volume of curious queſtions. Theſe extracts ſufficiently evince the laudable and ſtrenuous endeavours of the ſocieties, and their great zeal for the promotion of uſeful knowledge. I cannot reſtrain myſelf from copying an article that preſented itſelf to me on looking over the Medical Journal in taking theſe extracts;

extracts ; although it is in ſome meaſure deviating from the ſubject, its curious ſingularity, I hope, will excuſe the inſertion :—— Doctor Brownrigg, of Ormſthwaite, in Cumberland, well known by ſeveral ingenious publications to the lovers of philoſophical chymiſtry, in a letter to one of his friends, a celebrated phyſician, in London, ſays, That he, ſeveral years ago, diſcovered a method of converting air, a ſubtil elaſtick inviſible fluid, into a ponderous, palpable, and viſible body. This promiſes to be a capital diſcovery, leading to others of great moment, for which reaſon, adds the Doctor, I have ſat brooding over it theſe thirty-five years. Being unwilling the diſcovery ſhould die with him, he intends to publiſh his obſervations and experiments on this ſubject, or, at leaſt a conſiderable part of them, next winter. I ſhall make no remark on the Doctor's invention, but wiſh he may bring his ſcheme to ſuch perfection that he may build a ſolid houſe of air for himſelf ; if he does, the publick ſhould enable him to furniſh it.

Theſe philoſophers, Doctors Prieſtley and Brownrigg, ſeem, like repulſion and attraction, to antagonize each other, the one reducing ſolids to elaſtic inviſible fluids, while the other reduces elaſtic inviſible fluids to ſolid matter. But to reſume the object of this eſſay ; the deſign of which is, among other things, to point out the neceſſity of learned inſtitutions for promoting literary purſuits,

ſuits, as alſo their importance to the community, and the national honour which they reflect; and the diſgrace and indignity which attends their neglect: For this purpoſe I have endeavoured to demonſtrate the advantages accruing from ſcientifick ideas. In point of arriving at greater degrees of improvement in the various arts, and armed with ſome knowledge of chymiſtry, I ventured to bring in queſtion the propriety of an Act of our Legiſlature the laſt ſeſſion; and, laſtly, I have, with great diffidence in my own judgment, and great deference to any oppoſite opinions may be held, thrown out ſome hints on a new ſpecies of manure for land; and, in order to raiſe emulation, I have held out the example of other nations, by giving an account of a few of their prize queſtions.

But as the inſtituting academies is not the only means conducive to propagating ſcience, I will mention one more, as it ſeems to me ſo eſſential for this purpoſe. What I mean is, the eſtabliſhing a Profeſſorſhip for Public Lectures on natural philoſophy and chymiſtry. The beſt plan might be to blend both, in a manner the moſt ſuitable, to extend the underſtanding, by comprehending the moſt curious and neceſſary parts of each in clear language, free from technical terms and mathematics, by which they would be brought to a level with common capacity. After this method, the celebrated Abbe Nollet

let conducted his lectures, in the Royal College of Naverre, Paris. While his ſimple and unaffected ſtile gave the utmoſt pleaſure to every hearer, his ingenious experiments afforded occular demonſtration of the truth of his doctrine: So that in his leſſons, he mingled delight with inſtruction. Such an inſtitution would be found productive of more generally inſpiring a taſte, and diffuſing the ſeeds of philoſophick knowledge, in a land where, from the genius of the natives, they would ſpring up with vigour.

The ingenious mechanic would, by ſuch a courſe of lectures, become more enlightened, by receiving fundamental ideas relative to the principles of his art, by which, he would be better enabled to bring it to a ſtate of more improvement. The gentleman and nobleman might, by the ſame means, imbibe inſtruction at an eaſy rate, which would not only prove an ornament and ſolid comfort, but more truly dignify them than the accidental diſtinctions of birth or fortune, as every perſon is ſenſible how often theſe latter are beſtowed on the ignorant and worthleſs. It is a conſideration ſhould make their poſſeſſors more ſanguine for ſome more honourable diſtinction, than what merely comes from theſe contingencies.

It muſt be allowed, there is no country where there is more money laviſhed than in

Ireland, to ſo little purpoſe, in order to excite national induſtry and encourage improvements. It is only the manner of expenditure I combat. It is certain, that the Linen Board and Dublin Society, diſtribute the moſt liberal premiums; but, for want of due examination, or from ſome other defect, they are, according to the beſt information I could get, obtained oftner by fraud than merit, as corruption and perjury are too often the claimants chief modes of operation. I live in a country where ſome of this kind of gentry have ſprung from poverty to opulence, according to the report of the neighbourhood, by the moſt iniquitious practices. The mind revolts from dwelling on ſo dark a ſubject. I ſhall only ſay, that to enrich knaves by premiums they did not merit, is, in the literal ſenſe, giving the children's meat to dogs. But the means I propoſe, are pure and honourable, and do not admit of the leaſt deceitful practice. They ſoar above the mean cunning of ſuch villany. Learning and induſtry would join hand in hand, and be of mutual ſupport to each other. While philoſophy, like an enlightened guide, would point out the ſtraight path, induſtry could generouſly repay her guide for the trouble.

Among the various arts which ſhould be the objects of national encouragement, certainly phyſick ſhould not be deemed the laſt. The following paſſage, from Boerhaave's Academical Lectures, puts the matter in a proper light.

light. Therefore, the neceſſity, uſefulneſs, and dignity of phyſick are ſufficiently apparent.

" The ſervice of phyſick, is evident from the effects we daily find from the practice of it; without it a great part of mankind would not live out their days; and ſtill a larger number of great men, being oppreſſed with pain and diſeaſe, would ſpend their lives uſeleſs to the publick. Some have, indeed, objected, that every man may be his own phyſician. But it will readily appear, that a man employed in other affairs, cannot be ſo perfectly acquainted with the neceſſary doctrine of phyſick, as thoſe who have made it the entire buſineſs of their whole life; nor is it poſſible they ſhould have the like opportunities of learning anatomy, pharmacy, &c. And as for theſe reflections, which are caſt with contempt on phyſick by the illiterate, they have aroſe from the ignorance of ſome unſkilful practitioners, and not from the deſerving art itſelf.

" The uſefulneſs of phyſick in a republic, is both well known and eſteemed, eſpecially as it is ſo extenſive as to touch the life and health of every individual member. The eſteem for it has always been ſo great, that people afflicted with diſeaſes, had rather apply themſelves to any ignorant perſon than be without phyſick. But it is very evident that thoſe who know any thing of phyſick, will not inconſiderately commit themſelves to the raſhneſs of pretenders. The moſt ancient heroes, and even the bold Achilles, were not altogether unſkilled in phyſick; nor did they think it beneath them to practiſe it with their own hands. Our Saviour is a remarkable inſtance in this reſpect, who, being inveſted with divine power, alſo made it his particular care to relieve the bodily diſorders of mankind."

The length of this quotation might demand an apology only it is Boerhaave's opinion of the point in queſtion; and where I can put in his words, their authority ſhould carry ſuch weight, in upholding my ſentiments, that it induced me to inſert the paſſage at full length. And if we conſider farther, how far the enjoyment of good health exceeds every other ſublunary advantage, and that the ſcience of preſerving it when preſent, or recovering it when loſt, is ſtill far from being arrived at ſufficient maturity, what views can appear more intereſting, what efforts more laudable, than ſuch as are directed to excite an emulation in its profeſſors towards its farther improvement by encouragements, ſuch as other nations in their wiſdom holds out for this purpoſe?

As I have, in the beginning of the firſt Section, aſſerted the facility of making artificial ſpas, and their extenſive benefit if properly encouraged, I ſhall here ſay a few words on this article, with which I ſhall conclude the preſent work. The diſorders theſe apply to, generally originate from too full a diet, accompanied with a ſtate of indolence and inactivity, from which generally proceed, various complaints of the ſtomach, and ſometimes confirmed viſceral obſtructions. It is too frequently the caſe that eating and drinking is made the great buſineſs of life. Theſe diſciples of Epicurus, who addict themſelves to the luxuries of the table, ſcarce know any other topick for converſation than their ſide diſhes, their head and foot ones, their different ſauces, and rich flavoured wines; until at length, loſing all reſolution, they give themſelves up without reſtraint to the enjoyments of the palate; and when they neglect to counteract the baneful effects of ſuch indulgence, by labour and exerciſe, by giving way to a lazy inactivity, they grow bloated and ſtuffed with groſs and pituitus humours, by which the whole man becomes relaxed and enervated. Nature cannot aſſimilate or animalize this ſurcharge of indigeſtible materials for any length of time, the excretory veſſels being choaked ultimately, for want of motion. According to the expreſſion of a late ingenious author, the conſtitution breaks up, and the ſolids rot in their juices. He alſo obſerves, that the power of the conſtitution, to convert food into nouriſhment, depends upon, and keeps pace with, the ſimple information of hunger only: in other words, that the digeſtion is in proportion to the appetite. If, therefore, we continue to eat by incitements of the palate, after hunger ceaſes, we muſt of courſe convey more into the ſtomach than can be converted into the purpoſes of life, which, by indigeſtion, will become a ſource of diſeaſe. If a fever is eſcaped, chronick complaints certainly enſue, and moſtly of the bilious and hypochondriac type, in which the ſtomach is principally engaged. The pituitous accumulation in theſe caſes being of an alkaleſcent tendency, there being commonly a great redundancy of bile, which regurgitating into the ſtomach, occaſions the moſt oppreſſive ſickneſs and diſtreſſing anxiety. Our views in theſe caſes muſt be turned to the correction of the alkaline acrimony, and of the redundancy of bile. In theſe caſes, along with the uſe of other medicines, mineral waters afford remarkable aſſiſtance.

As the principles of the different mineral waters are various, ſo ſhould their uſe. To know their right adaption therefore, on good grounds, it is abſolutely neceſſary to aſcertain their principles, whether they are of the claſs of Chalybeate waters, or Chalybeate purging waters; ſulphureous, or ſulphureous purging waters; acidulous, ſaline, or vitriolick waters; or ſuch as contain an earth; as their medical properties muſt evidently depend upon their manner of impregnation; and as they ſo widely differ from each other in that reſpect, it becomes neceſſary to know the method of analyſing them. The moſt approved is the following:

Waters are known to contain iron, by their exhibiting a purple or black colour, with infuſion of galls, and the quantity of iron they contain is known by the intenſity of the colour.

If fixed air be the diſſolving menſtruum, it will fly off on being expoſed in an open veſſel, and the iron will fall to the bottom in form of a yellow or reddiſh powder.

But if the iron be held in ſolution by acid of vitriol, this precipitation of ochre does not take place.

The Chalybeate vitriolic water will be alſo diſcovered by its auſtere ſtyptick taſte.

If, on the addition of ſirup of violets to any water, it turns of a bright green, it is an evidence of an alkaline impregnation. The foſſil alkali is the only one ever found in mineral waters.

But if the ſirup of violets, inſtead of a green is changed to a red, it is a teſt of an acid impregnation.

But as earthy and metallic ſubſtances change alſo ſirup of violets green, to be certain the impregnation is an alkaline one, add ſome fixed alkali, and if no powder falls to the bottom, or any turbidneſs enſue, it is beyond doubt the foſſil alkali, which impregnates the water.

If water contains ſea-ſalt, oil of vitriol dropped into it, will cauſe white noxious fumes to ariſe, which is the acid of ſea-ſalt, that is diſplaced by the vitriol having a ſtronger affinity to the alkaline baſis of the ſea-ſalt.

If a mineral water contains Epſom ſalt (the purging ſalt commonly found in mine-waters) an addition of fixed alkali will precipitate a white powder (magneſia alba).

Sulphureous waters are known by their ſmell, and by changing ſilver of a copper colour.

If water contains earth deprived of fixed air, it may be known by adding fixed air to it, as the water will become turbid and the earth fall to the bottom.

If, on the contrary, it contains an earth ſuperſaturated with fixed air, by expoſing the water in an open veſſel, the earth will alſo precipitate.

The ſolid matters contained in waters may alſo be known, by evaporating the waters and examining their reſiduum.

I have now in the conciſeſt manner ſhewn the common teſts, by which the various principles of mineral waters are known.

Firſt, to evince, that according to their different impregnation, their medicinal properties muſt conſequently vary, and that their indiſcriminate uſe ſhould be diſcouraged. And, ſecondly, I have given theſe teſts as it may induce ſome curious in that way to try ſuch waters, as they have reaſon to ſuppoſe are of a mineral nature.

The principal foreign mineral waters uſed in this kingdom, are the Seltzers, Briſtol, Pyrmont, and Spa, according to the moſt accurate analyſes made by Profeſſor Bergman. A cantharus (a Swediſh meaſure, containing 100 cubick inches of Seltzer water) contains of calcareous earth, ſaturated with fixed air, 17 gr. of magneſia, ſaturated with the ſame, 29½ gr. mineral alkali chryſtallized 24 gr. its ſpecifick gravity compared to that of diſtilled water, in a temperate heat, was found to be 40027; it yielded 59 cubick inches of fixed air, and only one of common air: it contained of common ſalt 109½ gr.

A ſimilar quantity of Spa water contains of iron, diſſolved by fixed air, 3¼ gr. calcareous earth, diſſolved by the ſame, 20 gr. alkaline mineral alkalazatum 8½ gr. common ſalt 1 gr. its ſpecifick gravity 10010, and it was found to contain 45 cubick inches of fixed air.

Pyrmont water afforded ferrum aeratum 3¼ gr. of calx aerata 20 gr. calx vitriolata

$38\frac{1}{2}$ gr. magneſ. aerat. 45 gr. magneſ. vitriol. 25 gr. ſal commune 7 gr. Its ſpecifick gravity to that of diſtillated water, was as 10024, fixed and it yielded 90 cubick inches of air.

Being accommodated with a proper machine to impregnate water with fixed air, Doctor Nooth's is convenient for this purpoſe. Theſe ſpas are made artificially with great exactneſs and equal in every reſpect to the natural. There is this farther advantage in the artificial, they may be made ſtronger, or weaker, or have their principles varied, according to the exigence of the caſe.

To make Seltzer water, take of diſtilled water impregnated with fixed air 11 lb. take of common ſalt 12 gr. well dried, mineral alkali $111\frac{1}{2}$ gr. For Spa water take of the ſame mineral alkali $1\frac{1}{3}$ gr. of common ſalt $\frac{2}{5}$ gr.

For Pyrmont water, take Epſom ſalt $11\frac{1}{5}$ gr. of common ſalt $2\frac{3}{5}$ gr. Theſe ingredients are to be put in the quantity of water mentioned, (viz. 11lb.) being firſt impregnated with fixed air.

To the two laſt waters the ſpa and pyrmont; there is to be added about 20 grains of pure iron fileings, free from ruſt, ſuſpended in a clean linen bag; the water will diſſolve the requiſite quantity.

The gypſum and calx may be added in the quantities mentioned in the analyſis of theſe waters. The waters are pleaſanter without them, and agree better with ſome ſtomachs, and produce more ſalubrious effects.

The Briſtol water is light and clear, impregnated with few contents, which are of the genuine calcarious and abſorbent kind, of which there is contained 50 grains in a gallon.

The Mallow and Swadling Bar, and Lucan are the moſt eſteemed indigenous ſpas.

The Mallow is ſo analogous to the Briſtol ſpa, it might entirely ſuperſede the uſe of the other in this kingdom. The Swadling Bar, and Lucan are entirely ſulphureous. The ſulphur is diſolved, by a calcarious earth, or an alkaline ſalt: theſe waters may alſo be eaſily imitated, by boiling ſulphur in lime water.

Having gone through the analyſis, and compoſition of theſe waters, their application will be the more evident, as by having attained the knowledge of the extraneous ſubſtances they contain, their effect can be better foreſeen: theſe waters are reckoned attenuating and deobſtruent, they are cooling, they correct acrimony, or where an acid or redundant bile prevail in the primæ viæ, they are of eſſential uſe; they prove effectual, in ſour, or bitter vomiting, or in diſeaſes brought on by hard drinking, in loſs of appetite, in flatulency, heart-burn, colicks, in anomalous gout attacking the ſtomach and bowels. They are the beſt preventive: their virtues are applauded in ſcurvies, in nervous diſeaſes, artabilary complaints.—

They quench thirſt, cure diſeaſes of the ſpleen from hot cauſes, and the jaundice likewiſe, acrid degenerated bile is ſubdued by them, they temperate the heat of the liver, they exhilarate the ſpirits, abſterge viſcid tartarous humours, clean the blood, and corroborate the nerves; theſe virtues are indiſcriminately attributed to mineral waters in general. But certainly in adminiſtering theſe helps, the heterogeneous particles that impregnate them, ſhould be well conſidered, that they may be juſtly adapted to the patient's caſe.

The Seltzer and Briſtol, are free from ferugineous particles; notwithſtanding they reſemble in that inſtance, there is however a material difference in their principles. The Seltzer being rich of mineral ſalt, the Briſtol of calcarious, abſorbent earth.

Therefore in a relaxed ſtate of the ſolids, where the ſecretions are increaſed in conſequence, and an acidity prevails, the Briſtol merits the preference: the Seltzer water I look upon to be beſt adapted, where there is room to ſuſpect the exiſtence of ſome viſceral obſtruction, becauſe it contains more of the mineral alkali, which is the leaſt aſtringent, and the moſt inciſive detergent principle contained in any mineral water.—After premiſing a trial of either of theſe, the Pyrmont or ſpa waters may come in with better advantage; it is certain that in many caſes the Seltzer or Briſtol water ſhould precede the uſe of the ſpa or Pyrmont, as theſe laſt have a chalybeate impregnation, for which reaſon if given firſt, they might rather confirm than remove the obſtruction. The exhibition of chalybeates therefore ſhould be poſtponed on this account, as from their iron impregnation they are found ſo often to diſagree with weak irritable habits, which by a previous uſe of the milder alkaleſcent minerals, may be ſo far improved as to bear the adminiſtration of the latter, which if given firſt might ruffle the conſtitution, eſpecially where there is a ſlow fever, a fulneſs in the veſſels, a redundancy of bile, in all which caſes from the aſtringent effects of iron, the chalybeate ſpas if firſt adminiſtered might be of prejudice, and tend to increaſe the morbid ſymptoms.

To do any juſtice to this ſubject would lead into an ample field of diſcuſſion, and a more minute enquiry. I have only touched on the ſubject to ſhew the error of the indiſcriminate uſe of mineral waters; and indeed each being too warmly extolled in every chronick caſe, and in every attending circumſtance of ſuch caſes, imperceptibly leads into the error of indiſcriminate uſe, and hinders in practice a proper line of diſtinction to be drawn between them. To proceed farther would lead me beyond the limits of a pamphlet which it is not my intention at preſent to exceed: I ſhall only obſerve that in broken down habits, and nervous patients, it is often abſolutely neceſſary to aſſiſt the effects of theſe waters by other powerful remedies; they may ſometimes be taken in conjunction with the tonick tribe of medicines. Peruvian bark, colombo root, cold bath, hold the firſt place, along with which exerciſe, friction, company, amuſements ſhould not be omitted. Among the ſedatif medicines, opium, camphrozinc flowers, caſtor, aſafœtida, valerian root, are of the greateſt efficacy. It is by judiciouſly trying different methods in theſe forelorn caſes, that we at length hit upon the right and ſucceſsful one; but by perſeverance in the proper means, debilitated wrecked conſtitutions may be generally reſtored to priſtine vigour, and the full enjoyment of health, and by a continued temperance the ineſtimable bleſſings may be ſecured, until the conſtitution, wearing equably by the gradual approaches of old age, theſe quondam invalids after enjoying a green old age, drop like ripe fruit. This kind of gentle tranſition from this life to the other, is thus beautifully depicted by Goldſmith.

Onward he moves to meet his latter end,
Angels around defending virtue's friend;
Steals to the grave, with unperceiv'd decay,
Whilſt reſignation gently ſlopes the way;
And all his proſpects, bright'ning to the laſt,
His heaven commences ere this world is paſt.

6 DE 58

FINIS.